Every galaxy in its humour: three galaxies with the suspected unusual stellar M/L appear to have the kinematically decoupled inner discs.

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Abstract. We performed long-slit spectral observations of three galaxies which were previously suspected as the galaxies with peculiarly low mass-to-light ratios of stellar population based on the galaxy mass estimates from the HI linewidths: NGC5347, UGC1344, UGC11919. The observations were conducted with the Russian 6-m BTA telescope and were aimed to clarify the kinematics and stellar population of the galaxies. The results of the observations disproved the peculiar mass-to-light ratio in all three galaxies. For UGC11919 the inclination angle appears to be lower than it follows from the photometry, NGC5347 possesses high velocity dispersion which leads to the high asymmetric drift correction increasing the velocity, the measured rotation velocity of UGC1344 turned out to be at least 3 times higher than that calculated from the HI linewidth.

The interesting detail that we found and studied in all these galaxies is the presence of kinematically decoupled nuclear component. In UGC11919 and NGC5347 the age of stellar population is lower for the innermost part in comparison to that of the bulge. The metallicity of the central region is higher than that of the bulge for NGC5347 and UGC1344 and slightly lower for UGC11919, revealing the possible different formation histories of these nuclear components. All three galaxies possess bars, which could provide conditions for the formation of the nuclear kinematically distinct structures.

Observations and data reduction. We carried out the long-slit spectroscopic observations of UGC11919, NGC5347, UGC1344 with the SCORPIO spectrograph (Afanasiev & Moiseev 2005) with the Russian 6-m BTA telescope in 2013, 2015 and 2016. We obtained the spectra of UGC11919 and UGC1344 for two position angles ($PA_{1,2}$=20, -52^0 and $PA_{1,2}$=45, 82^0). For NGC5347 we performed three spectral slices with different position angles ($PA_{1,2,3}$=120, 103,30^0).
The parameters of internal kinematics and stellar population of the galaxies were obtained by fitting high-resolution PEGASE.HR (Le Borgne et al. 2004) simple stellar population models using the NBURSTS full spectral fitting technique (Chilingarian 2007).
For UGC1344 we also probed a non-parametric stellar line-of-sight velocity distribution (LOSVD) recovery technique, which does not require a priori knowledge of the LOSVD shape (for more details on the technique see, e.g., Katkov et al. 2011).

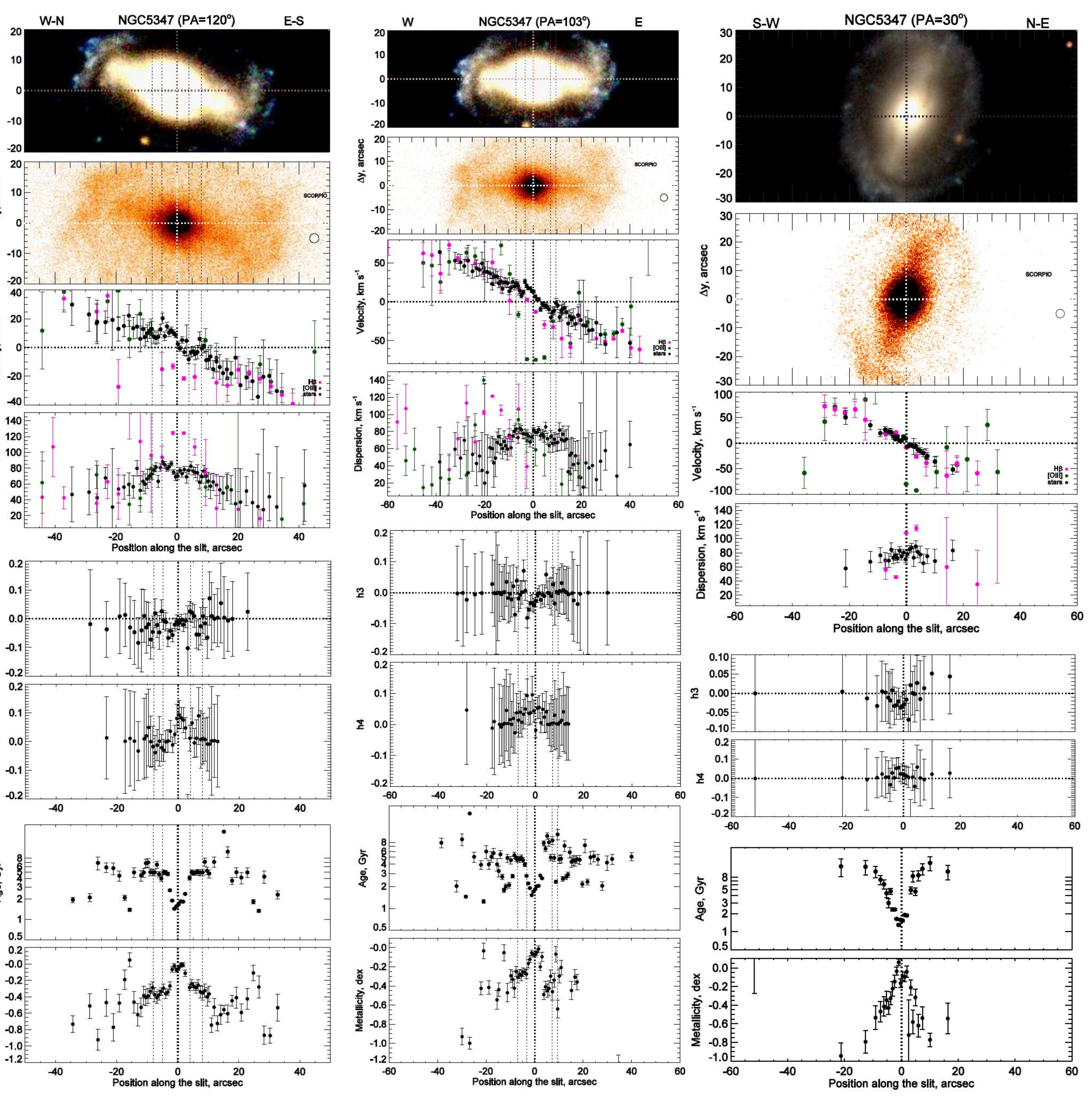
Properties of the galaxies:

Galaxy	Distance, Mpc	Morph. type	m_{B}, mag.
UGC11919	74	SABb	12.9
UGC1344	58	SBa	12.98
NGC5347	32	Sab	13.16

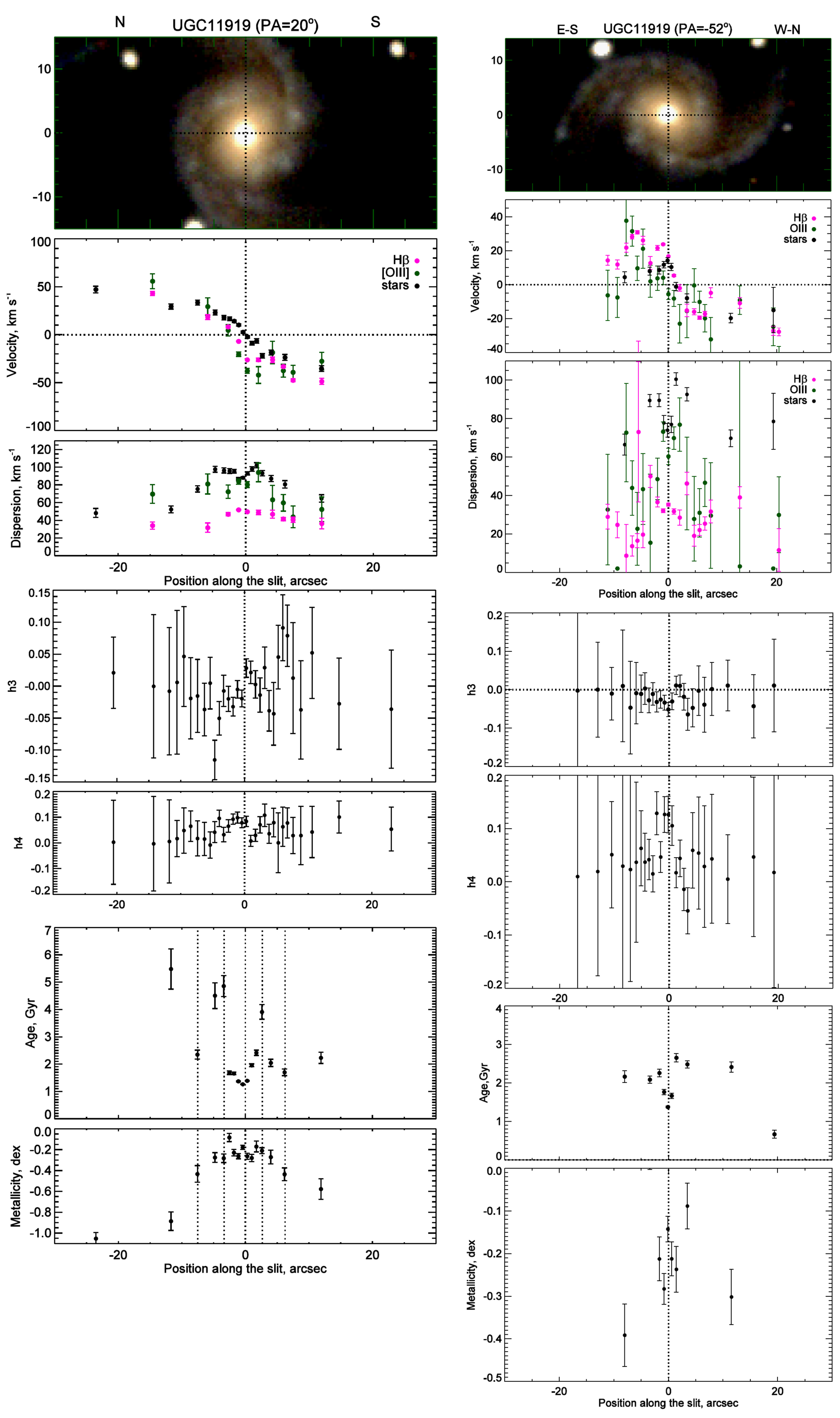
Radial profiles of the parameters of the kinematics and the properties of stellar population of UGC11919, UGC1344 and NGC5347 for different positions of the slit.

Top panels below are the reference images, where horizontal line shows the position of the slit. Next two panels demonstrate the velocities and velocity dispersions of stars (black points) and ionized gas (colored symbols). The zero points for the velocity are: 5370 km/s (UGC11919), 4390 km/s (UGC1344), 2410 km/s (NGC5347). Next two graphs show the profiles of Gauss-Hermite moments h3 and h4. These parameters characterize the deviation of LOSVD from the Gaussian profile. The value of h3 is related to the skewness of the LOSVD, while h4 is a measure of the kurtosis. Two bottom panels describe the age and metallicity of stellar population. Vertical dashed lines on the diagrams mark the position of the center of a galaxy and the regions where the velocity gradient changes.

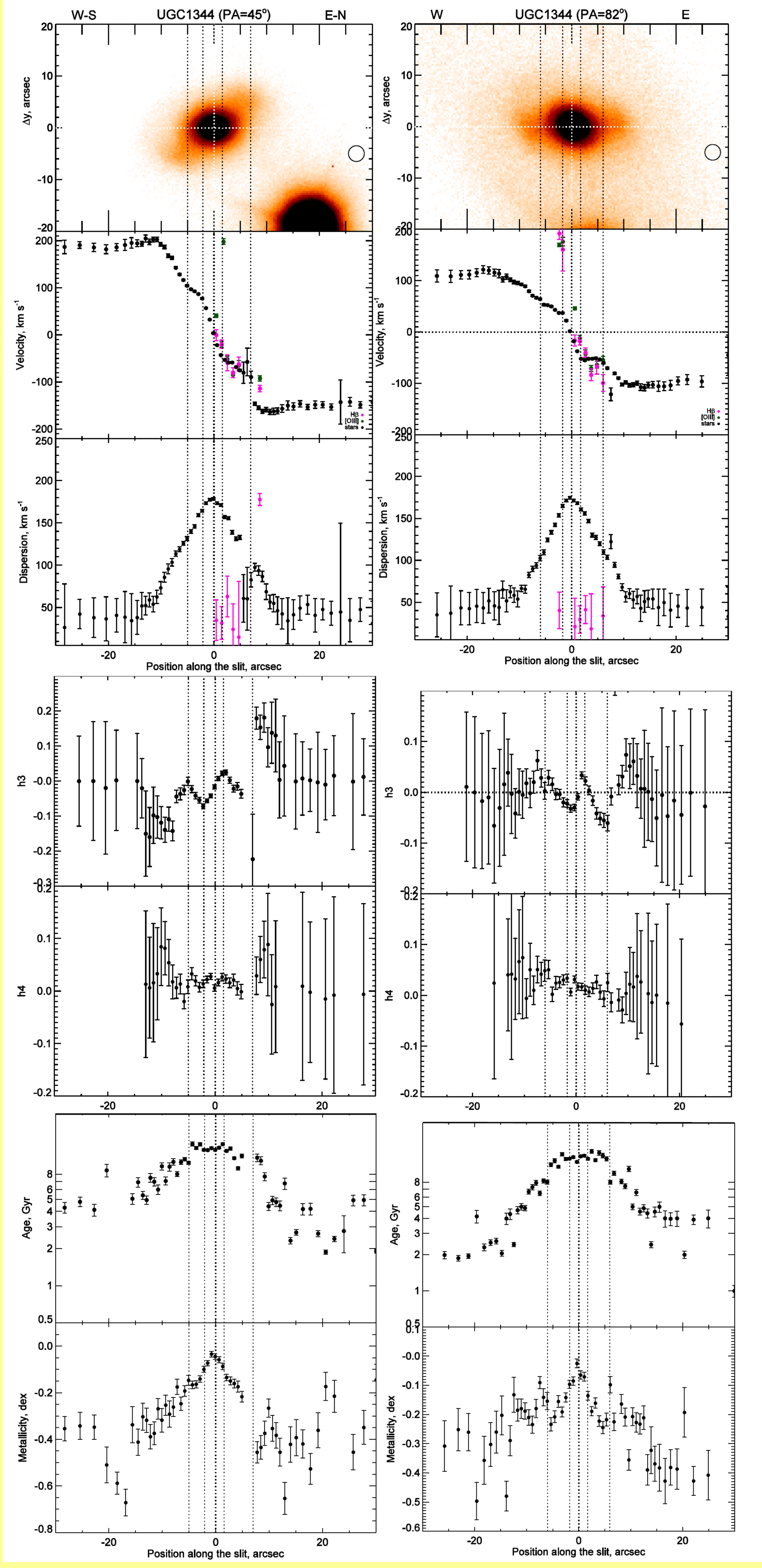
NGC5347:



UGC11919:



UGC1344:



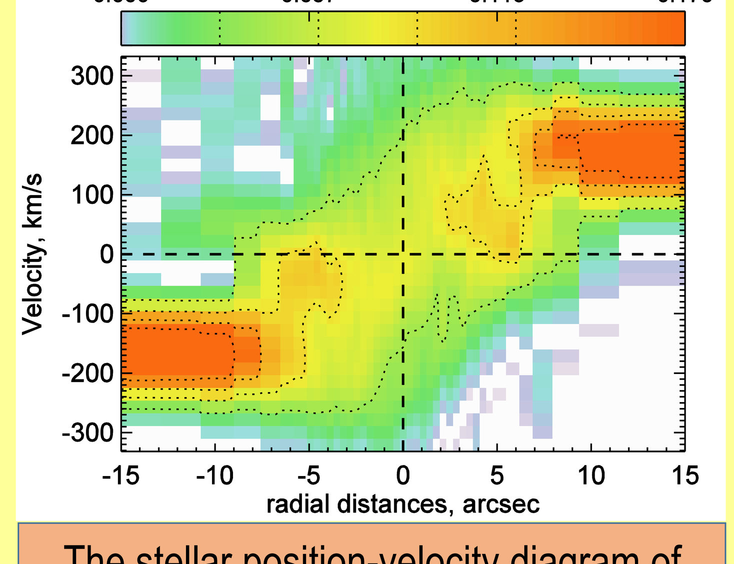
The line-of-sight velocity profiles of NGC5347 and UGC1344 show the change of radial gradient in the inner regions (marked by dashed vertical lines). This change is typical for barred galaxies and is reproduced by the simulations (see e.g. Bureau, Athanassoula, 2005). At the same time the inner radial profiles of h3 anticorrelate with the velocity profiles for all considered galaxies (for UGC11919 the h3 data are, however, uncertain). It is the clear sign of the kinematically decoupled inner substructure (inner disc or nuclear ring, see e.g. Seidel et al., 2015). UGC11919 and NGC5347 reveal the presence of the central minimum of the stellar velocity dispersion and age which could be another indication of the nuclear disc. In these two galaxies the age of the nuclear component is close to that of the main disc, while the bar is relatively old. In contrast UGC1344 does not demonstrate the decrease of the velocity dispersion and age in the center. It may evidence the different formation history of the inner components in the considered galaxies. However, it seems that in all three cases the bar could contribute to the formation of the nuclear substructures by providing the central regions with radially migrating gas.

On the mass-to-light ratios.

UGC11919: For inclination i=30^0 which is in a good agreement with photometrical and HI observations: M/L_B=0.5 which is 3 times lower than follows from the photometry and model M/L - color relations. However, the stellar velocity dispersion estimates allowed us to evaluate the inclination from the disc thickness. We found that the much lower inclination i=13^0 is in better agreement with stellar velocity dispersion, that corresponds to "normal" M/L ratio (for more details see Saburova et al., 2015).

UGC1344: For the rotation velocity calculated from the HI linewidth V/sin(i)=56 km/s: M/L_B=0.34, which is 6 times lower than follows from the photometry and model M/L - color relations. However, our estimates of the velocity appear to be 3 times higher than that from the HI linewidth and disprove the peculiar M/L.

NGC5347: For the rotation velocity calculated from the HI linewidth V/sin(i)=63 km/s: M/L_B=0.78, which is approximately 3 times lower than expected from the photometry and model M/L - color relation. However, according to our data the velocity dispersion in NGC5347 is comparable to the velocity, leading to the asymmetric drift correction that enlarges the velocity estimate by 1.5 times. The new value of the velocity disproves the abnormal M/L ratio in the galaxy.



The stellar position-velocity diagram of UGC1344 obtained for stellar LOSVD non-parametric recovery technique for PA=45^0. The inner part of the diagram gives evidences in favor of kinematically decoupled stellar component.

Conclusions.

We obtained the long-slit spectra with the Russian 6-m BTA telescope for three galaxies (UGC11919, UGC1344, NGC5347) which originally were selected as having peculiarly low mass-to-light ratios of stellar population. However, the peculiarity of mass-to-light ratio was disproved by the new kinematical data. But we found that all three systems possess the nuclear kinematically decoupled stellar components. The evidences in favor of this finding are the following:

-- the inner parts of the h3 radial profiles show anticorrelation with the velocity profiles for all considered objects;

-- two of three galaxies (UGC11919, NGC5347) demonstrate also the central minimum of the stellar age and the velocity dispersion;

-- the stellar position velocity diagram obtained using non-parametric LOSVD recovery technique for UGC1344 also demonstrates the signs of the inner stellar component probably with different orientation in comparison to that of the main disc.

The formation of all three nuclear components was most likely supported by the bar which can fuel the central star formation by delivery of the gas to the central areas. Notably, the ages and metallicities of the studied kinematically distinct cores behave differently in comparison to that of the main discs and bars. For NGC5347 and UGC11919 the nuclear disc has the young age comparable to that of the main disc. For UGC1344 the central profile of the age is flat and the central component is significantly older than the outer disc. The stellar metallicity has the central maximum for UGC1344 and NGC5347 while for UGC11919 it is slightly lower than that of the bar. These characteristic features can reveal the possible differences in the formation history of the nuclear components in the galaxies.

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